MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during July, 1885, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic ocean during the month are also given, and their approximate paths shown on chart i.

July, 1885, like the preceding month, has not been marked by any abnormal meteorological features.

On chart i. are traced the paths of nine atmospheric depressions; these, with four minor depressions (not charted), are described under "Areas of low barometer." The average number of depressions charted for July during the last twelve years corresponds with the number for July of the current year.

The most violent and destructive local storms of the month occurred in Minnesota, Wisconsin and Michigan, on the 8th, during the prevalence of low area iii.

The mean temperature in all districts corresponds very nearly with the July normal.

Marked deficiencies in the monthly precipitation occurred on the Atlantic coast and in the Ohio valley; in the district last named and in New England the average precipitation was about one-half the normal amount. In other districts the average precipitation, as compared with the normal, shows no decided excess or deficiency, although at certain stations the departures, both above and below the normal, were quite marked.

Over the north Atlantic ocean the weather was generally pleasant, the month being free from violent storms.

The area of the region covered by icebergs in the north Atlantic is less than in the preceding month; these dangers to navigation now seem to be disappearing.

In the preparation of this REVIEW the following data, received up to August 20th, 1885, have been used, viz.: the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and twenty-nine Signal Service stations and twenty-one Canadian stations, as telegraphed to this office; one hundred and fifty-six monthly journals and one hundred and sixty-two monthly means from the former, and twenty-one monthly means from the latter; two hundred and eighty-seven monthly registers from voluntary observers; reports from 1,421 special tornado observers; forty-six monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs, furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Ohio, Indiana, Missouri and Nebraska, and of the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE.

[*Expressed in inches and hundredths.*]

The distribution of mean atmospheric pressure for July, 1885, determined from the tri-daily telegraphic observations of the Signal Service, is shown by the isobarometric lines on chart ii.

The mean pressure is least over the central and southern Rocky mountain regions, where the monthly barometric means range from 29.75 to 29.85, the lowest being reported from Fort Thomas, Arizona; it is greatest in the south Atlantic and Gulf states, and on the north Pacific coast, where the means range from 30.00 to 30.04, the highest occurring at Key West and Sanford, Florida, and Fort Canby and Tatoosh Island, Washington Territory.

As compared with the mean pressure for the preceding month, an increase is shown over the southern plateau, the eastern Rocky mountain slope, west Gulf states, southern Florida, northern New England, and the Maritime Provinces. Except over the Maritime Provinces and a part of the southern slope, where the increase varies from .05 to .07, the barometric means in the districts before-named range from .01 to .05 higher than those for June. In all other districts the pressure is lower than that for the preceding month, the deficiency exceeding .05 on the northern California coast, over the region to the north of the Ohio and Missouri rivers, and in the southern part of the middle Atlantic states.

The departures from the normal pressure at the various stations are given in the table of miscellaneous meteorological data; they are also shown on chart iv. by lines connecting stations of equal departure. It will be seen from the chart named that there are no marked departures from the normal. On the Atlantic coast, over portions of the northern slope and lake region, and in the southern districts from the Mississippi river to the Pacific coast, the pressure is slightly above the normal, the departures being generally less than .05. In the remaining districts slight deficiencies are shown, the maximum departures occurring over the extreme northwest and the north Pacific coast region, where they vary from .05 to .07.

MONTHLY BAROMETRIC RANGES.

The monthly ranges were greatest in the extreme northwest, Saint Vincent and Moorhead, Minnesota, reporting the maximum, .82; they were least in southern Florida and over the southwestern part of the country from the west Gulf states to the Pacific coast. The smallest monthly ranges are as follows: .16, at Fort Davis, Texas; .20, at Fort Grant, Arizona, and Fort Stockton, Texas; .23, at Key West, Florida. The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous meteorological data.

AREAS OF HIGH BAROMETER.

I.—The feeble anti-cyclonic area over the upper Mississippi, Missouri, and Ohio valleys dominated the weather conditions during the 1st. During the 2d this area became central near Cairo, but moved to the south and east. During the 3d it pushed to the south Atlantic and east Gulf states, where it continued to rest during the 4th, with occasional rains in the Southern states on this date. The isobar of 30.00 inclosed this

area since its appearance. During the 4th a part of this area appeared to become detached and rest over the north Atlantic coast, where it continued as a decided high area till the 8th. The high area in the south Atlantic and east Gulf states continued, but without any energy, till the 6th, when the crowding down of the low increased the pressure, and from this date till the 9th it prevailed in the southern districts. The phenomena described as low area number xiii. is interesting as having occurred in the west margin.

II.—This area continued over the north Pacific coast from the 2d till the 5th, when it disappeared; its general characteristic was an absence of rainfall over that region.

III.—This area appeared on the 8th in Montana, following the storm-centre before it. By midnight of the 9th it had advanced as far as Minnesota. During the 10th it was prevalent from the Missouri river to Lake Huron, but more feeble; the departure from the normal was only slight. This high was accompanied by a cool wave from the Missouri valley to the middle Atlantic coast. During the 11th it had moved eastward to New York, and its centre during the 12th was over the Atlantic coast, its western margin not disappearing till after the 13th.

IV.—During the 13th the pressure rose on the north Pacific coast, remaining stationary till the 16th, when the area became central over the Columbia valley, within the isobar of 30.1, but soon disappeared.

V.—An anti-clyclonic area with no gradients was present on the Atlantic coast the 16th, and was intensified by the passage of the low to the north and at the same time pushed into the Southern states. During the 17th, in the rear of the advancing low, the pressure rose in the upper Mississippi valley and upper lake region, which, during the 18th, coalesced with that in the Southern states and a high area prevailed from Canada to the Gulf, but was most decided in the lake region. During the 19th it was scarcely perceptible, having spread out over all districts east of the Mississippi river. It was under the influence of this area that some of the excessively warm days occurred on the Atlantic seaboard.

VI.—This area became apparent on the north Pacific coast on the 18th and continued with constant conditions till the 24th. The characteristics of clear weather were continued, as in like areas before-mentioned.

VII.—During the 20th this area appeared, with slight energy, in the northwest, following a low area. During the 21st it became more feeble and during the 22d spread from the Saint Lawrence valley to the Gulf of Mexico, so continuing during the 23d, passing off Nova Scotia on the 24th, the southern portion continuing over the Southern states during the 25th.

VIII.—This area followed a depression in its advance, but was of only slight energy. During the 25th it was north of the lake region. During the 26th it dropped down to New England, and with the depression over Chesapeake bay came the relief from the great heat that had prevailed for eleven days. During the 27th this area moved off Nova Scotia.

IX.—This appeared in Manitoba on the 30th, not advancing further than Minnesota by the end of the month.

AREAS OF LOW BAROMETER.

During the month eleven areas of low pressure or cyclonic disturbances passed within the field of observation made by the reports. Nine of these are charted, from i. to ix., inclusive. Numbers x., xi., xii., and xiii. were feeble depressions and need but mention in the study as accounting for heavy rain occurrences and high temperatures. Number i. is a continuation of number vii. for June.

In this REVIEW is given the lowest barometer reading found within the area of depression, also the amount of greatest departure found within the isobar inclosing the area. Numbers iii. and vii. developed considerable energy for summer cyclonic areas, and are represented on chart i., by heavy lines showing portions of paths of greatest severity.

The abnormal paths taken by numbers i. and ii. are remarkable for their westerly movement. The close succession of one area after another during the first part of the month, with the absence of any decided depression during the latter portion, is worthy of note. The location of all paths to the northern portion of the United States and in Canada, except small local developments of cyclonic character as far south as Tennessee, characterize July, 1885. The average progress of storm-tracks is in excess of the mean as determined for several years, which is 24.6 miles per hour.

The following table gives the latitude and longitude in which each area was first and last observed, and the average hourly velocity for the three periods between the observations and also during the storm:

Areas of low barometer.	First observed.		Last observed.		Average velocity in miles per hour			
	Lat. N.	Long. W.	Lat. N.	Long W.	11 p. m. to 7 a.m.	7 a.m. to 3 p. m.	3 p.m. to 11 p.m.	During storm.
	° ′	° ′	° ′	° ′				
No. I	43 00	69 00	47 30	70 00	14.4	13.7	22.5	17.4
II	42 00	105 00	51 00	95 00	14.2	19.6	20.3	18.2
III	46 30	112 00	45 00	67 00	49.6	30.6	40.6	40.2
IV	51 30	110 00	48 30	68 00	23.3	19.1	31.9	24.7
V	38 00	75 00	39 30	72 30	.....	10.2	.....	16.2
VI	51 30	105 00	43 00	88 0	31.9	30.0	27.5	29.9
VII	46 00	112 00	48 30	68 00	27.1	33.7	30.3	30.4
VIII	44 30	100 00	44 30	63 00	17.5	31.6	32.5	27.8
IX	43 00	100 30	47 00	85 00	28.7	10.0	58.7	32.5
Mean hourly velocity					25.0	24.0	30.1	26.4

I.—On the morning of July 1st a depression rested over the coast of New England; in the afternoon the centre of depression was located east of the White mountains, where heavy rains occurred, raising the rivers in central Maine. The pressure was gradually increasing to eastward and was falling to the westward over the lake region. At the same time rains were reported in the provinces to the northeastward, but none west of New England, as appeared from the Signal Service telegraphic reports. At midnight the pressure continued falling to the westward, and on the 2d rains fell over Lake Erie and the middle Atlantic states. From this time till the disappearance of the depression no decided barometric changes occurred, while the rainfall was gradually diminishing. The abnormal westward movement may be accounted for by the barometer falling to westward, its rising to eastward, and the feeble influences existing to create any decided movement, and instead of there being a distinct progressive storm-centre this might be said to be a large and nearly stationary depression resting over this region, indicated by the storm track. During the 1st and 2d brisk and occasionally high westerly winds occurred from Maine to the Virginia capes, and southerly winds at Eastport, where a number of vessels were delayed.

The following shows the lowest barometer readings and greatest departure from the normal:

July 1st, 7 a. m., 29,60, departure, —.31; 3 p. m., 29.61, departure, —.25; 11 p. m., 29.63, departure, —.26. July 2d, 7 a. m., 29.67, departure, —.24; 3 p. m., 29.68, departure, —.15; 11 p. m., 29.80, departure, —.14. July 3d, 7 a. m., 29.78, departure, —.13; 3 p. m., 29.78, departure, —.07; 11 p. m., 29.84, departure, —.06.

II.—A considerable depression overlay the upper Mississippi and Missouri river valleys and westward to the Rocky mountains prior to this development, but in the afternoon of the 4th a decided fall was observed near its western edge at Cheyenne, Wyoming, and thence to Huron, Dakota. During the first eight hours the greatest fall of the barometer took place in northern Dakota, thus moving the centre of depression forward to near Huron. The barometer continued falling from Manitoba to Missouri, and the depression covered a large area, which was central near Moorhead, Minnesota, early on the 5th. During this date the pressure fell in Michigan and Manitoba, rising between these sections. The depression moved to Lake Superior and afterward receded northwesterly. During the

6th heavy rains and dangerous winds occurred on the western lakes, with frequent thunder-storms. The low area during the 6th and 7th central in Manitoba remained nearly stationary, with steep gradients and heavy rains to the southeast.

July 4th, 3 p. m., 29.70, departure, —.11; 11 p. m., 29.69, departure, —.21. 5th, 7 a. m., 29.63, departure, —.29; 3 p. m., 29.55, departure, —.36; 11 p. m., 29.59, departure, —.36. 6th, 7 a. m., 29.49, departure, —.44; 3 p. m., 29.27, departure, —.49; 11 p. m., 29.24, departure, —.59. 7th, 7 a. m., 29.21, departure, —.62; 3 p. m., 29.41, departure, —.47.

III.—This area should be closely studied in connection with the preceding one which, while resting north of Minnesota and Dakota, pushed southward from it in a tongue-shaped area late on the 7th. On the 8th was formed into an area with distinctly separate depressions in Colorado, in southern Minnesota, and in Manitoba, the latter being the general depression, number ii., which continued in this region. Heavy rains and high winds prevailed in the disturbed sections during the night of the 8th, when it passed beyond the boundary of the United States. This area assumed the long oval shape which always are accompanied by severe winds, move rapidly, and are generally the most severe character of storm developments which occur in the lake regions. This cyclonic disturbance is charted as most severe during the night of the 8th and after. It was within its influence that severe thunder-storms, hurricanes, hail storms, and tornadoes occurred north of the fortieth parallel and east of the Missouri river. At La Crosse heavy rain, with thunder, fell from 7.30 to 9.20 p. m. and hail for ten minutes, ending at 8.25; for five minutes the wind blew at the rate of 48 miles per hour. This storm came from the north and did considerable damage to crops. Milwaukee, a thunder-storm occurred during the night of the 8th and 9th, passing from nw. to se. A large elevator was damaged by lightning. Reports from Tomah and Sparta and vicinity, in the interior, state that the storm was very severe. Grand Haven, a thunder-storm prevailed during the night of the 8–9th, the wind reaching a velocity of 36 miles per hour from sw. The life-saving crew report the storm as exceedingly severe for the season. At Rochester a gale prevailed from 9.05 a. m. till 4.30 p. m. the 9th, being sw., 32 miles, at 10.40 a. m. The following shows stations and time of severe winds on the great lakes: Duluth, 12 midnight, 8th, for two hours; Escanaba, 9 p. m., 8th, till 10.30 p. m.; Milwaukee, 12 midnight, 8th, ending 11.45 a. m.; Chicago, 1 p. m., 8th, till 12.30 a. m. 9th; Grand Haven, 2.45 a. m. till 4.30 a. m., 9th; Alpena, 12.30 a. m. till 2 p. m., 9th; Port Huron, 11.45 a. m. to 4.30 p. m., 9th; Detroit, from midnight till 2 p. m., and fresh till 6 p. m., 9th; Sandusky, 10 p. m., 7th, till 7.30 a. m., 9th; Cleveland, 9 a. m., 8th, till 10 a. m., 9th; Erie, midnight, 9th, till 4.30 p. m.; Buffalo, 6 a. m., 8th, till 10 p. m., 9th, highest during the afternoon of the 9th; Oswego, 6.30 a. m., 9th, till 2.45 p. m. The following occurrences of tornadoes or severe local storms are recorded: tornado west of Saint Paul, 3.25 p. m., 8th; southwest, at 6.30 p. m.; southeast, at 5 p. m. In Wisconsin the tornadoes occurred between 6 and 8 p. m. of the 8th, and in Michigan, southeast of Grand Haven, at midnight. The next afternoon the tornado occurred in Massachusetts at 4.35 p. m., in Maine at 3 p. m.; and the gales of hurricane violence throughout New England, eastern New York, New Jersey, and eastern Pennsylvania, occurred in the evening from 3 to 10 p. m. Prior to the advent of this storm very oppressive temperatures, much above the normal, had prevailed from New England to the west, causing several cases of sunstroke in New York. After reaching the Gulf of Saint Lawrence the area moved southwest over Maine and then again eastward, but with no severity.

The following shows the lowest barometer and greatest departure for this storm at each report:

July 7th, 11 p. m., 29.69, departure, —.22. 8th, 7 a. m., 29.57, departure, —.35; 3 p. m., 29.68, departure, —.26; 11 p. m., 29.65, departure, —.27. 9th, 7 a. m., 29.65, departure, —.23; 3 p. m., 29.53, departure, —.32; 11 p. m., 29.53, departure, —.32. 10th, 7 a. m., 29.60, departure, —.30; 3 p. m., 29.55, departure, —.32.

IV.—This appeared on the 11th as a depression in the Saskatchewan valley, which spread out and moved central over Manitoba by midnight, causing heavy rains in northern Dakota. During the 10th the movement was rapidly to the southeastward to Lake Superior, attended with gales and heavy rains in its advance. During the 13th the area, as represented by the isobars, appeared as a tongue reaching down to the south Atlantic coast, but central near Lake Erie. Very heavy rains fell from Florida to Canada under its influence, and exceedingly heavy rains in Pennsylvania, flooding many streams. A hail storm occurred at Indianapolis, p. m., 13th. The extreme southern portion of this tongue might be described as a subsidiary depression, developing over Tennessee, which was soon merged into the more general one to the north. The sudden movement to the south, shown on the chart during the 13th, is to be attributed to the uniting of these depression areas. Closely related to this, another distinct depression on the following day, described as number v., and which appears likewise to have coalesced with the more general one, passing slowly down the Saint Lawrence valley till it disappeared.

The following shows the lowest barometer and departure from the normal for this storm within its lowest isobar:

July 12th, 7 a. m., 29.60, departure, —.31; 3 p. m., 29.57, departure, —.29; 11 p. m., 29.65, departure, —.28. 13th, 7 a. m., 29.66, departure, —.27; 3 p. m., 29.67, departure, —.22; 11 p. m., 29.63, departure, —.25. 14th, 7 a. m., 29.65, departure, —.28; 3 p. m., 29.64, departure, —.24; 11 p. m., 29.66, departure, —.25. 15th, 7 a. m., 29.64, departure, —.20.

V.—This area, as in description of the previous low, might be called subsidiary to it, or as a breaking away of the southern end of the tongue that, on the midnight of the 13th, extended from Canada to Georgia. It became, on the morning of the 14th, a distinct depression over Chesapeake bay and accompanied by very heavy rains on the Atlantic coast within its influence. By midnight of the 14th it merged into the greater depression to the north. The weather now cleared and a drought followed, with exceedingly high temperatures in the Atlantic states till the end of the month. The barometer and departures were as follows: July 14th, 7. a. m., 29.67, departure, —.30; 3 p. m., 29.65, departure, —.28.

VI.—This depression followed quickly behind number iv., advancing rapidly from the Saskatchewan valley to Lake Michigan during the 13th and 14th, and during the night of the latter merged into low number iv., or was lost in the general depression which prevailed over the entire northern sections of the country. It was accompanied by no decided rains or gales. The lowest barometer and greatest departure from the normal is shown by the following: July 13th, 3 p. m., 29.63; 11 p. m., 29.67, departure, —.23. 14th, 7 a.m., 29.68, departure, —.30; 3 p. m., 29.65, departure, —.26; 11 p. m., 29.72, departure, —.23.

VII.—This cyclonic area developed in Montana on the afternoon of the 14th, and by midnight had assumed the shape of a long oval from Fort Buford, Dakota, to Salt Lake City, Utah. During the 15th it developed into a decided cyclonic area central over Dakota, with heavy rains and severe gales in its front and a tornado in southern Dakota. During the 16th it continued in severity, advancing across Minnesota, and at midnight was central over northern Lake Michigan. Threatening weather, with gales and thunder-storms, occurred on its south and east sides. Its severity rapidly diminished on the 17th, and with a rapid movement from the early morning of this date it disappeared in the Gulf of Saint Lawrence. During this rapid movement only occasional gales occurred in the lower lakes, but with a dangerous, brisk, southwesterly wind. During the passage of this storm from the evening of the 15th to the 17th the chart indicates its severity. A tornado occurred west of Huron, Dakota, between 6 and 7 p. m., the 15th. At Fort Maginnis, Montana, a northerly and northwesterly gale blew during the 15th and 16th. Fort Totten, Dakota, 15th, a very

destructive hail storm, about four miles wide, occurred about 11 p. m., between Niagara and Reynolds. It is estimated that $200,000 worth of wheat was destroyed. Fort Buford, Dakota, 15th, an easterly gale began at 3.45 p. m., continuing till 8.25 next morning. The wind veered to northwest and on the 16th blew at the rate of forty-nine miles. A thunder-storm occurred at 7.30 p. m., moving from the west, it was accompanied by a very heavy fall of hail, lasting about thirty seconds. Moorhead, Minnesota, 15th, a thunder-storm prevailed, with rain at intervals, during the evening. At 8.58 p. m., heavy hail fell, lasting eight minutes, the hail-stones being from one-half to one inch in diameter and in sufficient quantity to cover the ground to the depth of two inches or more. Reports show that but little hail fell, except in vicinity of Moorhead, Minnesota, and Fargo, Dakota. The damage to gardens was great.

The following shows the commencement and ending of strong winds, with direction and highest velocity during the storm for all the lake stations, viz:

Duluth, 16th, 3 p. m. till 11 p. m., sw., 28 miles; Marquette, 16th, 3 a. m. till 2 p. m. 17th, s., 30 miles; Escanaba, 16th, 6 a. m. till 2 p. m. 17th, s., 24 miles; Milwaukee, 16th, 8.30 a. m. till 6 a. m. 17th, s., 35 miles; Chicago, 16th, 1 p. m. till 1 a. m. 17th, s. 22 miles; Grand Haven, 16th, 8 a. m. till 8 p. m. 17th, s., 36 miles; Mackinaw City, 16th, 10 a. m. till 3 p. m. 17th, sw., 32 miles; Alpena, 16th, 8 a. m. till 10 p. m. 17th, sw., 28 miles; Port Huron, 16th, 9 a. m. till 10 p. m. 17th, se., 22 miles; Detroit, 16th, 11 a. m. till 7 p. m. 17th, s., 25 miles; Toledo, 16th, 12 m. till 8 p. m. 17th, se., 21 miles; Sandusky, 16th, 12 m. till 3 p. m. 18th, sw., 20 miles, and nw., 24 miles; Cleveland, 16th, 2 p. m. till 6 p. m. 17th, sw., 22 miles; Erie, 16th, 9 p. m. till 9 p. m. 17th, sw., 16 miles, and w., 20 miles; Buffalo, 16th, 10 p. m. till 10 p. m. 17th, sw., 29 miles; Oswego, 16th, 10 p. m. till 10 p. m. 17th, sw., 16 miles.

This cyclonic area diminished after passing over the lakes and did not impinge upon the high over the Atlantic states, and only served to increase the southerly winds which heated more and more the middle Atlantic coast districts. The highest temperature ever recorded at Albany, New York, occurred on the 17th, being 96°.6; also at New York City much suffering occurred this date. At Block Island, Rhode Island, also, the highest temperature, 87°.8, ever recorded by the Signal Service occurred the 18th. This storm was unlike that of the 8th, being opposed by a strong barrier in the form of a high on the middle Atlantic coast. No local storms of note occurred on its southeastern margin and the effect of increasing the south and southwest winds brought on the most excessively hot weather. The storm of the 8th had a high in the Southern states, and with local depression formations in its southern portion, which were entirely absent in this low area.

The route of its feeble influence after the 17th was down the Saint Lawrence valley. The following gives the intensity of the depression:

July 14th, 3 p. m., 29.70, departure, —.18; 11 p. m., 29.59, departure, —.30. 15th, 7 a. m., 29.54, departure, —.40; 3 p. m, 29.47, departure, —.49; 11 p. m., 29.40, departure, —.57. 16th, 7 a. m., 29.35, departure, —.57; 3 p. m., 29.44, departure, —.50; 11 p. m., 29.56, departure, —.36. 17th, 7 a. m., 29.81, departure, —.11; 3 p. m., 29.66, departure, —.19; 11 p. m., 29.58.

VIII.—A depression had overlaid the Rocky mountain region for some days, and on the afternoon of the 18th began developing in a slight depression in Dakota. During the night a rapid fall to the westward retarded its further movement, but a tongue projected from the main depression eastward towards the lakes and soon formed into a long oval-shaped low area extending from Manitoba to northern Texas, but with the lowest departure in southern Dakota. High winds, thunder-storms, and rains already fell in the upper lake region in its advance during the afternoon of the 19th. During the 20th the movement was rapid towards lake Huron, but attended by no strong gales; heavy rain was abundant. During the 20th the depression moved over New England, causing a few high winds on the coast north of the Delaware capes, and a hurricane with heavy rain in northern Pennsylvania. At Milwaukee, and vicinity, on the 19th, a severe storm occurred, with heavy rain and thunder; the highest wind-velocity was thirty-six miles per hour. At Chicago, on the 19th, an unusual fluctuation of temperature occurred, as follows: 11 a. m., 86°; 11.40 a. m., 67°; 12 m., 70°; 7 p. m., 92°. At New London, on the 21st, a thunder-storm was accompanied by an electric display such as is seldom witnessed; it began at 5.50 p. m. and continued for nearly an hour, many buildings were struck, and many persons experienced dangerous shocks.

The following shows the lowest barometer and greatest departure within the area of depression: July 18th, 3 p. m., 29.79, departure, —.11; 11 p. m., 29.83, departure, —.11. 19th, 7 a. m., 29.74, departure, —.19; 3 p. m., 29.62, departure, —.28; 11 p. m., 29.68, departure, —.22. 20th, 7 a. m., 29.73, departure, —.15; 3 p. m., 29.76, departure, —.13; 11 p. m., 29.80, departure, —.13. 21st, 7 a. m., 29.74, departure, —.20; 3 p. m., 29.68, departure, —.20; 11 p. m., 29.73, departure, —.20.

IX.—This was a very slight depression, but was attended by remarkably heavy rains in Nebraska, and especially at Omaha, being 2.57 inches. The movement of this depression was at first slow but during the night of the 23d it passed into Canada, with light local rains. It has been observed, during this, that when a depression hovers for some time in one locality that unusually heavy rains generally result.

The lowest barometer and greatest departures were as follows:

July 23d, 7 a. m., 29.75, departure, —.15; 3 p. m., 29.79, departure, —.10; 11 p. m., 29.83, departure, —.11. 24th, 7 a. m., 29.82, departure, —.07.

X. [not charted].—During the night of the 25th very heavy rainfalls occurred in the Missouri valley, which may be attributed to a projecting tongue reaching from a low over the Rocky mountain districts. Disturbed conditions were present from Nebraska eastward during the 25th and 26th, but without any depression of the barometer below the normal. A tornado occurred in northern Kansas, and hail, with heavy rain and wind, in southern Minnesota. Also a hurricane and heavy rain in southern Ohio on the 26th, during the afternoon.

Denver, Colorado, 26th, during the afternoon (at 1.47 and at intervals till 8.55), a thunder-storm generated; it was not severe at Denver, but at a place known as the "Divide," about forty miles south, a "cloud-burst" occurred which caused a destructive freshet in Cherry creek, which runs through Denver. As late as 5.30 p. m. it was entirely dry, as is usual at this season, at 6 p. m. the creek was so swollen as to overflow. The current was very rapid, resulting in great destruction to property; bridges and a number of houses were swept away. This freshet was the most destructive that has occurred since 1878.

At Pike's Peak and Colorado Springs a most terrific electric storm prevailed during the night of the 26th, with a waterspout or "cloud-burst" at Colorado Springs, which washed away some houses and drowned persons. Professor Strieby describes it very fully, an extract of which appears under "Floods." Omaha, Nebraska, 25th, a very severe thunder-storm occurred between 1.43 and 2.10 a. m., passing from se. to nw. Extraordinary rainfall, amounting to 2.74 inches, did considerable damage. Huron, Dakota, 26th, heavy hail fell thirteen miles north, causing damage to crops. Thunder-storms occurred during the 25th and 26th at all stations from the Rocky mountains to the Missouri river.

XI. [not charted].—This disturbance resulted from fluctuating conditions over east Tennessee, the Carolinas, and in the neighborhood of the middle Atlantic coast during the 26th and 27th. Occasional heavy rains and thunder-storms occurred. Steep gradients from a high in southern New England and the depression over Chesapeake bay caused gales on the coast of New Jersey and near Long Island. During this disturbance the barometer at no station within its influence was below the normal.

Baltimore, 26th, a thunder-storm, with heavy rain at intervals, prevailed from 3.10 to 8.15 p. m. Buildings were struck by lightning and considerable damage done by the flood. At the same time at New York the crops were suffering from a severe and protracted drought. At Washington City only light thunder showers occurred.

XII. [not charted].—During the night of the 28th the pressure was below the normal in all districts east of the Rocky mountains, but the greatest depression below the normal was observed in the northwest and from the Saint Lawrence valley to Georgia; these conditions continued on the 29th, with the depression never apparent on the Atlantic coast. In the northern portion of the upper Mississippi valley very heavy rain fell during the 29th, with winds reaching a hurricane violence in the vicinity of Dubuque, Iowa, Saint Paul and Moorhead, Minnesota, Fort Totten, Dakota, and many destructive hail storms occurred. During the 30th the depression was most decided near the Atlantic coast, with resulting brisk winds. It was during this period of undecided conditions that extreme heat prevailed over the entire country east of the Rocky mountains, being, however, most intense in the upper Mississippi and Missouri valleys, the extreme northwest and the northern plateau region.

XIII. [not charted].—On the 1st, on the west margin of high number I., a depression overlay the Rocky mountain region; an extension of this depression to the eastward caused steep gradients in Kansas. It appeared to extend eastward in a tongue shape over Kansas and the Indian Territory, which conditions continued, and on the 3d a local depression formed over the Ozark mountains in Arkansas and southern Missouri. The following remarkable rainfalls may be attributed to this phenomenon: Lamar, Missouri, severe southeast rainstorm began on evening of the 1st, continuing till noon of 2d, amount, 1.83. Heavy southeast thunder-storm began about 6 p. m. of 2d, continuing till after midnight. From 6.40 p. m., 3d, till 4 a. m., 4th, 4.44 inches of rain fell. The total of 6.27 inches fell in thirty-three consecutive hours, causing washouts on railroads and carrying away bridges. A train and bridge were washed away with the loss of three lives. Thunder-storms with rain also occurred on the 4th after heavy rain, and also on the 5th.

Fort Concho, Texas, 5th, a sand storm and hail and heavy rain storm occurred. Thunder-storms were frequent in the middle slope and west Gulf states during the period of this disturbance. Heavy rain also fell at time of severe storm in southeastern Kansas, and all rivers were flooded, which affected the Arkansas at Fort Smith the 5th, and rose till the 7th, when highest. At Little Rock the river began rising the 7th, rising rapily on the 8th, continuing till the p. m. of the 10th.

NORTH ATLANTIC STORMS DURING JULY, 1885.

[*Pressure expressed in inches and in millimetres; wind-force by scale of 0-10.*]

The paths of the depressions that have appeared over the north Atlantic ocean during the month have been determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports furnished through the co-operation of the "New York Herald Weather Service," ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to August 21, 1885.

Of the six depressions traced over the ocean, two, viz., numbers 3 and 4, were apparently continuations of disturbances which had previously traversed the north American continent, but neither of these appears to have reached the European coasts. The depressions charted were mostly unimportant and of slight intensity, the greatest force of wind rarely exceeding that of a fresh gale.

During the first five days of the month the atmospheric pressure over the ocean remained generally high, ranging from about 29.9 (759.4), on the Banks of Newfoundland, to 30.3 (769.6), between the meridians of 40° and 20° W. On the 6th a decrease of pressure set in over the region north of 50° N., and between 40° W. and the British coast, and continued, causing moderate gales and unsettled weather until the 10th. On the 8th a disturbance, number 2, apparently developed near 40° N., 48° W., and this, during its passage eastward on the following days, caused a general diminution of the area of high pressures which occupied the ocean between 40° and 50° N. After the passage of the above depressions an increase of pressure set in and the area of barometric maxima gradually spread over the ocean, the pressure continuing greatest over mid-ocean and least on the Banks of Newfoundland. The passage of a depression which was moving north of the fiftieth parallel, during the 18th, 19th and 20th, caused another slight reduction of pressure, principally over the ocean west of 30° W., until the 24th, when the high area again began to spread westward and continued, with slight fluctuation, until the closing days of the month.

The report of Captain I. L. Delap, of the bark "Mistletoe," shows the weather over the Atlantic during July, 1885, to have been unusually moderate, while many other vessels reported generally pleasant weather. The "Mistletoe" was bound from New York to Dunkirk, France, and during July sailed between 40° and 50° N., and from 50° W. to the English channel. Captain Delap remarks as follows: "From the 1st to 10th had very moderate, variable winds and generally smooth sea; on the 10th the wind hauled from wsw. to e., and increased to a moderate gale, with heavy and continual rain for twenty-four hours. The balance of the month was the most uniform weather I ever experienced; moderate winds, calms, and occasional fogs; through the channel had easterly winds, at times strong. I have never experienced the same weather in July in twenty-five years, a large portion of which was spent in the north Atlantic."

The following are descriptions of the depressions charted:

1.—Prior to the 6th an area of high pressures appears to have occupied the ocean between W. 50° and the European coasts and to have extended northward to the fifty-fifth parallel; on that date, however, a decrease of pressure occurred over the region north of 47° N., indicating the presence of a centre of depression probably far to the northward. The storm-centre cannot be located at the present writing, owing to the scarcity of reports from the northeastern part of the Atlantic, but it apparently remained north of 55° until the 10th, when it passed to the north of Scotland. The s. s. "State of Nevada," J. A. Stewart, commanding, came under the influence of this disturbance during the period from the 5th to the 9th, and reported fresh w. and sw. winds, increasing to moderate gales with rainy weather and high confused sea, barometer falling to 29.54 (750.3), at 11 a. m. of the 6th, in N. 55° 20′, W. 10° 0′. After rising to 29.76 (755.9) the barometer again fell to 29.54 (750.3), at 2 p. m. on the 7th, in N. 53° 45′, W. 21° 0′, and the wind suddenly shifted from wnw. to n. on the morning of the 9th. On the 7th the s. s. "Grecian," C. E. LeGallais, commanding, had barometer 29.46 (748.3), wind wnw., force 9, in N. 56° 45′, W. 29° 30′, and on the following day the same vessel, in N. 56° 24′, W. 36° 3′, had barometer 29.5 (749.3), wind wnw., force 6. On the 10th the bark "Jacob," A. Linder, commanding, in N. 60° 57′, W. 14° 0′, reported barometer 29.35 (745.5), wind sw., force 8, rainy and squally weather.

2.—This depression appeared on the 8th, near N. 40°, W. 47°, when the pressure in that neighborhood fell to 29.9 (759.4), being a decrease of about .4 inch since the preceding day. The disturbance moved slowly eastward, and on the 9th the lowest readings, about 29.6 (751.8), were shown near N. 41°, W. 45°. On the 10th the storm-centre was apparently to the northwestward of the Azores, causing moderate ne. to e. gales over the ocean between N. 40° and 46° and W. 30° and 40°; after this date the depression appears to have filled in, and an area of high barometer occupied the region between N. 40° and